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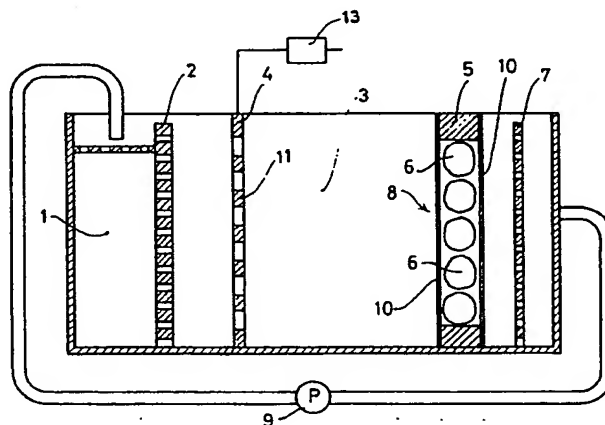
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**A process of manufacturing screen material, screen material as obtained, and installation for performing said process.**

In a process of manufacturing screen material (12) a metal matrix (11) is subjected to an electrolytic metal deposition by using an electrolytic bath containing a brightener, the liquid of the bath being forced to flow through apertures in the cathode (11) towards the anode (8). The metal deposits grow substantially perpendicular to the lands of the matrix (11) and thus form a screen (12) having apertures of approximately the same size as the apertures of the original matrix. Screen (12) can be removed from the matrix (11) by previously coating the latter with a separating agent such as beeswax. An installation for performing the process of the invention comprises a perforated cathode (11) as matrix, being fixed to cathode fixing means (4), a perforated anode (8) being fixed by anode fixing means (5) and a pump (9) for providing a forced flow of liquid through the apertures of cathode (11) towards anode (8).



A process of manufacturing screen material, screen material as obtained, and installation for performing said process.

The invention relates to a process of electrolytically manufacturing screen material by depositing a metal upon a matrix in an electrolytic bath, the latter containing at least one brightener.

- 5 U.S. Patent 2 226 384 describes a process of forming a screen by electrolytically depositing a metal upon a screen skeleton formed in a first stage. The screen formed by electrolytically depositing a metal on the screen skeleton can be removed, if required, by previously applying a stripping means, e.g. beeswax,  
10 to the screen skeleton.

*s d r*  
The disadvantage of this known process is that during the electrolytic deposition the lands as present in the matrix or screen skeleton grow in all directions, so that the screen material as finally obtained presents small passages with lands of substantially circular cross-section.  
15

*des'*  
It is an object of the present invention to provide a process which does not present this disadvantage and in which more particularly, the growth of deposited metal on the matrix or screen skeleton is effected solely or practically solely in one  
20 or two directions perpendicular to the matrix so that the original

dimensions of the apertures in the matrix or screen skeleton are fully maintained in the final screen.

With the process according to the invention, it is more particularly, possible to produce metal screens with or without the incorporation of the matrix, which screens combine maximum passage with maximum strength in any degree of fineness as required in practice, the apertures in the screen material increasing in size only towards one side, so that, when they are used as filter medium, there is little risk of clogging, contrary to processes in which there is a growth of the matrix in every direction.

clg. This object is attained according to the invention, in that the bath liquid is made to flow, at least during part of the electrolytic deposition, through the apertures in the matrix connected as a cathode.

15 More particularly it has been found that with a forced flow of bath liquid through the apertures in the matrix it is possible, by using certain speeds of the liquid, to achieve a condition in which metal deposition from the electrolytic bath occurs solely or practically solely, in one or two directions perpendicular to the matrix so that the apertures do not become smaller.

volumetric rate? The bath liquid is advantageously made to flow through the matrix at a speed of at least 0.005 m/sec, preferably of 0.05 to 1 m/sec. Preferably, the flow is into the direction of the anode and parallel to a perpendicular to the anode and cathode.

25 It has been particularly found that for a given speed of the liquid it is possible to adjust the cathode to a current density at which there is just no deposition of metal on the side of the matrix being remote from the anode.

More particularly it has surprisingly been found that it is not necessary to maintain the forced flow of liquid through the cathode for the entire period of the electrolytic deposition. The deposition of metal in the apertures of the matrix  
5 can already be prevented by applying a forced flow of liquid during just a very short time at the start of the electrolysis.

According to the process of the invention, optimum results are obtained when the electrolytic bath contains an organic compound containing at least one unsaturated bond not belonging  
10 to a  $\text{C} = \overset{\text{O}}{\underset{\text{O}}{\text{S}}} = \text{O}$  group, for example butynediol and ethylene cyanohydrin.

When these organic compound are used in combination with the forced flow of liquid it is possible to prevent the apertures in the matrix from becoming smaller during the electrolytic  
15 deposition.

More particularly it has been found that the shape of the land produced during electrolysis by means of a process according to the invention is controlled almost entirely by the following parameters:

1. 11.  
claim 12.
- 20
1. Quantity and type of organic compound used, more particularly a brightener of the second class;
  2. The current density on the cathode; and
  3. The speed of the liquid through the apertures in the matrix.

25 Although it is not possible to satisfactorily explain the above effects it is assumed that the flow of liquid and the organic compound used or one or more decomposition products thereof, results, at those places where the speed of the liquid exceeds a specific value, in a boundary layer which can not only prevent the deposition of metal, but also completely counteract it in

the process according to the invention.

Within certain limits, the required speed of the bath liquid through the apertures appears to be inversely proportional to the concentration of the said organic compound, more particularly a brightener of the second class.

It has additionally been found that with a given concentration of brightener and a given speed of the liquid it is possible to find at the cathode a current density at which there occurs just no metal deposition on that side of the matrix being remote from the anode. With a constant concentration of said organic compound, when the speed of the bath liquid is increased through the cathode-connected matrix towards the anode, the current density on the cathode is also increased without there being any metal deposition on the side remote from the anode. It will be clear that the formation of screens by a deposit of metal on just one side of a matrix is of great importance technologically.

It has been particularly found that the deposition of metal in the matrix apertures is completely prevented by a forced flow of liquid during a very short period, of e.g. one minute or less, at the start of the electrolysis, which then lasts for a total period of 45 minutes, for example. During the remainder of the electrolysis the forced flow of liquid can be reduced or even completely stopped.

This effect can be used in order to obtain all kinds of required shapes of land sections in the matrix without the dimensions of the apertures becoming smaller than those of the matrix.

Depending upon the type of organic compound in the form of a second-class brightener, the desired effect in the form of total

prevention of metal deposition in the plane of the matrix, by adapting the parameters in the form of current density and organic compound concentration, appears to occur at liquid speeds of 0.005 m/sec. as measured on the effective open  
5 surface of the matrix. From these calculation it appears that the Reynolds number in the aperture in the matrix is then much less than 2,100.

The process according to the invention is generally carried out with electrolytic bath liquid speeds comprised between  
10 0.05 and 1 m/sec.

Although the action of the organic compounds in the form of second-class brighteners according to the invention is not restricted to nickel baths, most industrial applications are in the application of nickel and nickel alloys.

15 Any metal can be used for the matrix, e.g. copper, while stainless steel is excellent as a matrix material for the production of nickel screens. Obviously nickel can also be used as matrix, in which case a matrix is provided with a layer of beeswax as a stripping means in order to enable the resulting screen to  
20 be removed from the matrix at a later stage.

The invention also relates to screen material, e.g. cylindrical screen material, obtained by using the process according to the invention.

Finally, the invention relates to an installation for performing  
25 the process according to the invention, comprising at least one anode fixing means, a cathode fixing means, an anode connecting element and a cathode connecting element, the installation being characterized in that it is provided with a liquid flow generating means for a forced flow of liquid through the cathode. The

installation is advantageously provided with a cathode current density adjustment and control means.

The invention will now be explained with reference to an embodiment by means of the drawing, wherein:

- 5 Fig. 1 is a matrix shown schematically;  
Fig. 2 shows the final material obtained by electrolytic deposition of a metal in case of normal growth of the deposited metal in all directions in accordance with the prior art.  
Fig. 3 is a vertical section through a bath for applying the  
10 process according to the invention.  
Figs. 4 to 10 illustrate different sections of screen material obtained by means of the process according to the invention.

- Fig. 3 shows an apparatus for executing the process according to the invention, with which it is possible to maintain a  
15 substantially constant speed of flow of the liquid in all the apertures of the cathode-connected matrix 11 in the electrolytic bath, even in the case of large surfaces of  $1 \text{ m}^2$ , for example.

- To this end, the electrolytic bath is provided with a first chamber 1 to which the bath liquid is supplied in an evenly  
20 divided state, chamber 1 being separated from the cathode-anode chamber 3 by one or more perforated partitions 2, having a number of small apertures such, that there is only a slight pressure head difference required, e.g. 5 to 10 mm, in order to produce the required flow.

- 25 Advantageously, anode 8 comprises one or more flow passages so that the bath liquid can flow through the anode at uniform speed as considered over the entire area of the anode.

An anode 8 with a flow passing through it is manufactured, for

example, by securing two pieces of titanium gauze 10 parallel to each other and parallel to the surface of cathode 11 which is to be treated as the matrix, and by filling the space between the two pieces of titanium gauze with small pieces of the required anode material 6.

In this way there is no disturbance of the required uniform flow of the bath liquid through the matrix arranged as cathode.

The forced flow of bath liquid is provided by pump 9.

If desired, it may be advantageous to separate the anode-cathode chamber from the chamber from which the liquid is pumped away, by means of a perforated wall 7, and an overflow partition, which latter can, for example, be provided with a special weir to measure the quantity of circulating bath liquid.

To secure the cathode 11, a cathode fixing means 4 is provided which can be connected to a cathode of an electric source.

To secure anode 8, an anode fixing means 5 is provided, which can be connected to the anode of an electric source.

The cathode fixing means 4 in this case acts as the cathode connecting element and the anode fixing means 5 as the anode connecting element.

The installation as shown may also be provided with a cathode current density adjustment and control means 13.

It will be obvious that in order to manufacture cylindrical screens the flow will be in an appropriately adapted direction through a vertically disposed cylindrical matrix material, while the anode will also be constructed in an appropriately adapted

cylindrical shape. It is also possible to use a radial flow from the periphery of the cathode to the centre. using an appropriate arrangement of the anode and cathode.

5 In the case of a cylindrical matrix, it may also be advantageous to mount the same rotatably around a horizontal axis and to suspend it partially in the bath liquid.

The invention will now be explained with reference to some examples.

#### EXAMPLE 1

10 A beeswax-coated nickel screen plate 11 is disposed vertically as the cathode in a known nickel bath, containing 80 mg of 2-butyne-1,4-diol per litre of bath liquid. The screen plate comprises apertures in the form of slots 120  $\mu$ m in width.

15 A nickel anode 8 is disposed parallel to and at a distance of 60 mm from the cathode 11.

A pump 9 provides a flow of liquid such, that the bath liquid flows through the screen plate apertures and towards the anode at a speed of 1 m/sec.

20 The d.c. current is 5 A/dm<sup>2</sup>, measured on the total unilateral surface of cathode 11.

The bath liquid temperature is 60°C.

After 60 minutes, the resulting end product has a land section as shown diagrammatically in Fig. 4. The nickel material as deposited can be removed in the form of a screen 12.

25 Under the same conditions as above, an identical portion of

screen plate was used and the liquid speed was reduced to 0.16 m/sec.

After 60 minutes the resulting end product had a section as shown diagrammatically in Fig. 5.

5 EXAMPLE II

Using the same nickel bath as above, the 2-butyne-1,4-diol concentration is increased to 160 mg/l. At a current density of 5 A/dm<sup>2</sup> and with a liquid speed of 1 m/sec., the product obtained after electrolysis for 60 minutes comprises a land section as shown diagrammatically in Fig. 6.

A fresh matrix plate is then fitted and under the same conditions the speed of the liquid is reduced to 0.16 m/sec., resulting in a product with a land section as shown diagrammatically in Fig. 7.

15 After a new screen plate had been fitted, the above conditions were maintained, but the current density was increased to 10 A/dm<sup>2</sup> and the electrolysis period reduced to 30 minutes. The end product as obtained comprised sectional lands as shown in Fig. 8.

20 EXAMPLE III

0.3 ml of a solution of hydroxypropionitrile as organic compound with an unsaturated bond is added to a nickel bath per litre of bath liquid. 2 G. of the sodium salt of benzene metadisulphonic acid are also added per litre of bath liquid.

25 A portion of matrix plate as described in the previous tests is subjected to an electrolysis for 30 minutes at a liquid flow of 0.16 m/sec. and a cathode current density of 10 A/dm<sup>2</sup>, the bath liquid temperature being 60°C.

The land section of the resulting end product is shown diagrammatically in Fig. 9.

#### EXAMPLE IV

5 A stainless steel piece of screen gauze with apertures in the form of slots of 120  $\mu$ m wide is placed in a nickel bath to which 80 mg of 2-butyne-1,2-diol has been added.

Using a current density of 5 A/dm<sup>2</sup> and a liquid speed of 0.16 m/sec., the end product obtained after 60 minutes has the land section shown diagrammatically in Fig. 10.

10 Part A represents the stainless steel matrix while the hatched part represents the area deposited by electrolysis.

Parts A and B are readily separable by applying a blade to a corner point, whereupon part A is reused for the same process.

#### EXAMPLE V

15 The preceding test is repeated with a cylindrical cathode having 120  $\mu$ m wide apertures.

The horizontally disposed cathode used as matrix is rotated and partially suspended in the liquid.

20 The product obtained after 60 minutes has the same properties as the one as shown in Fig. 10.

## Claims:

1. A process of electrolytically manufacturing screen material (12) by depositing a metal upon a matrix (11) in an electrolytic bath, the latter containing at least one  
5 brightener, characterized in that the bath liquid is made to flow, at least during part of the electrolytic deposition, through the apertures in the matrix (11) connected as the cathode.
- 10 2. A process according to claim 1, characterized in that the bath liquid is made to flow at a speed of at least 0.005 m/sec., preferably of 0.05 to 1 m/sec.
- 15 3. A process according to claim 1 or 2, characterized in that the flow is directed towards the anode (8) and parallel to a perpendicular to the anode (8) and cathode (11).
4. A process according to claims 1 to 3, characterized by  
20 one or more of the following measures:
  - a. the forced flow of the bath liquid is applied at the start of the electrolysis;
  - b. the bath liquid is made to flow through the apertures in the cathode (11) for a period of less than 10%  
25 of the total electrolysis time;
  - c. the forced flow of bath liquid is maintained for one minute at the start of the electrolysis in the case of a total electrolysis time of 45 minutes;
  - d. the cathode current density is adjusted to and maintained at a predetermined value;

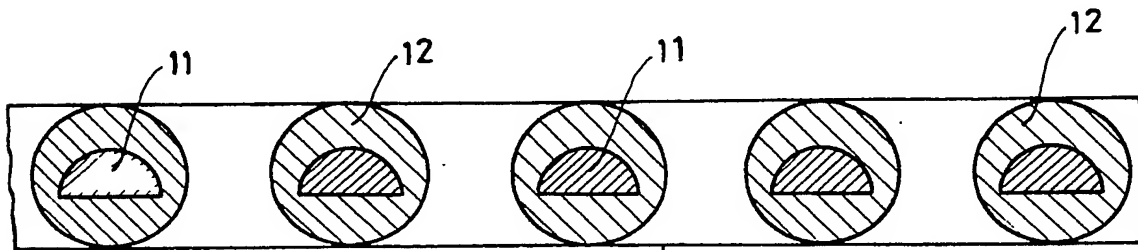
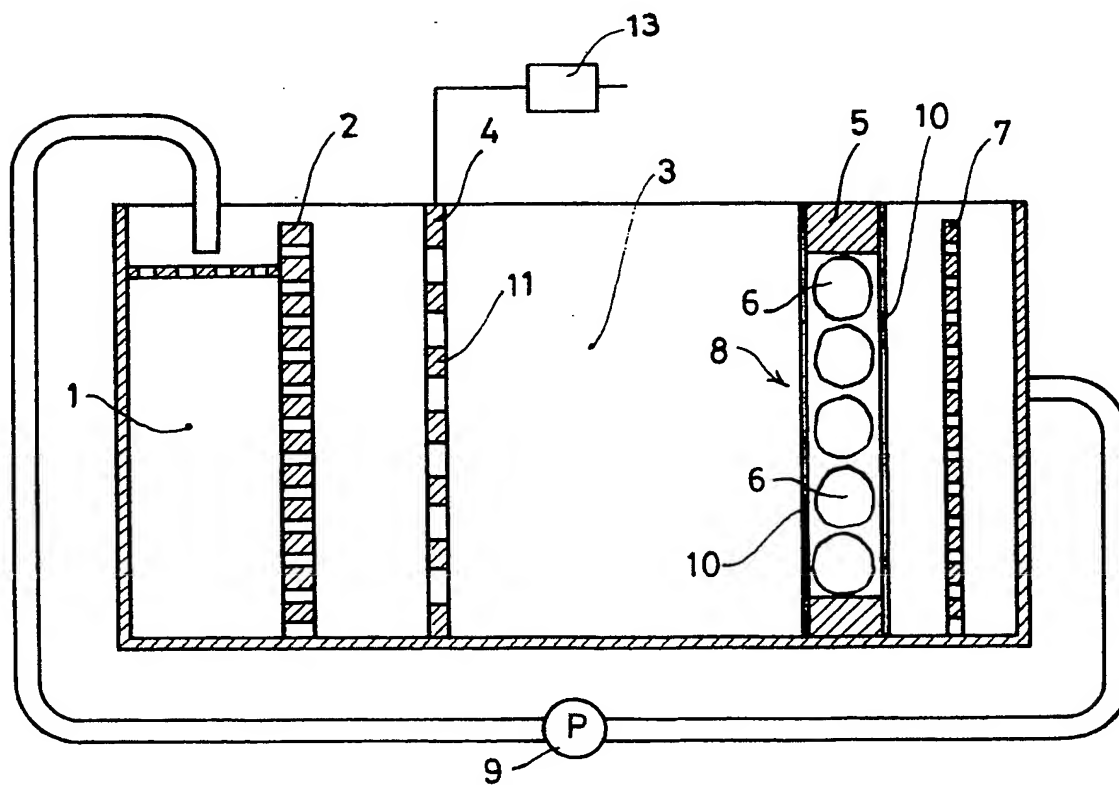
- e. the electrolysis bath contains an organic compound having at least one unsaturated bond not belonging to a  $\text{C}=\overset{\text{O}}{\underset{|}{\text{S}}}$  group;
- 5 f. the electrolysis bath contains an organic compound having at least a double or triple bond provided that the double bond does not belong to a  $\text{C}=\overset{\text{O}}{\underset{|}{\text{S}}}$  group, said compound being preferably a butyne diol and/or ethylene cyanohydrin;
- 10 g. the matrix (11) is given a surface treatment such that the electrolytically deposited material can be removed as a screen (12);
- h. a matrix formed electrolytically or otherwise is subjected to an electrolysis in an electrolytic bath containing an organic compound of the above type while a forced flow of liquid takes place through the cathode apertures and perpen-
- 15 dicular to the cathode (11) whereafter, with the cathode current density adjusted to the required value, the electrolysis is continued until the required total screen thickness has been obtained, whereupon the resulting screen (12) is removed from the matrix (11);
- 20 i. the matrix is produced by an electrolytic deposition;
- j. the matrix is a cylindrical matrix.
5. A screen obtained by applying the process according to anyone or more of the preceding claims.
- 25 6. An installation comprising an anode fixing means (5), a cathode fixing means (4), an anode connecting element and a cathode connecting element, characterized in
- 30 that the installation is provided with a liquid flow producing means (9) for the forced flow of liquid through a cathode (11) and preferably towards the anode (8).

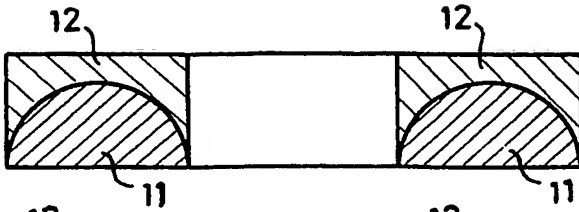
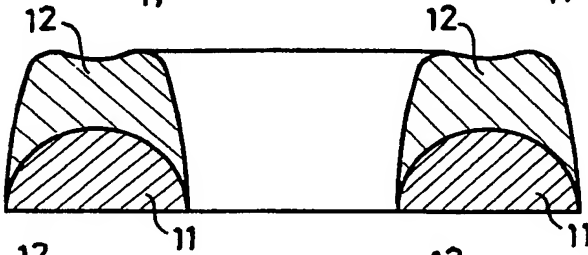
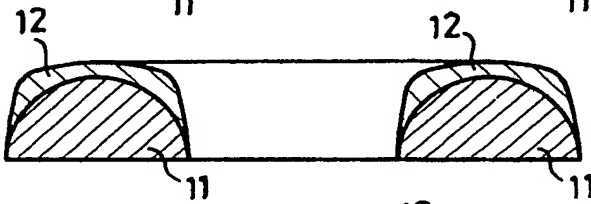
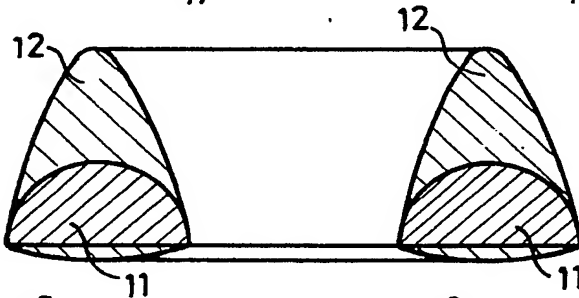
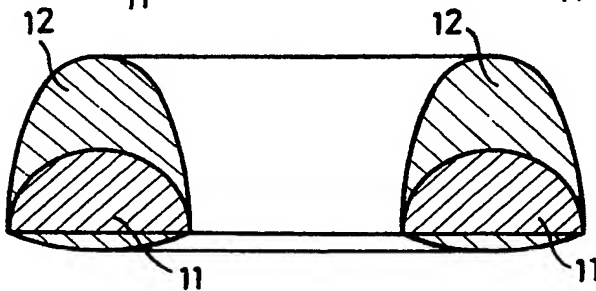
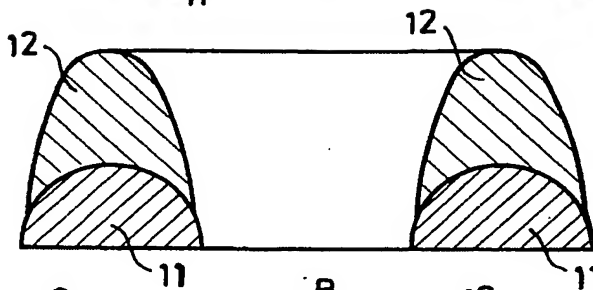
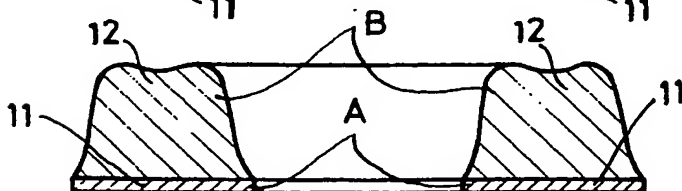
7. An installation according to claim 6, characterized in that the installation comprises one or more of the following parts:

- 5 a. the liquid flow producing means (9) produces a forced flow of liquid towards the anode (8);
- b. the installation is provided with a cathode current density adjustment and control means (13);
- c. the installation comprises rotation means for  
10 rotating a cylindrical cathode around its axis;
- d. the anode (8) is provided with apertures.

8. Screen material (12) produced by depositing metal from an electrolytic bath upon a matrix (11) using at least one brightener in the electrolytic bath,  
15 characterized in that the screen material is produced by having the bath liquid flow through the apertures in the cathode-connected matrix (11), preferably towards the anode (8) during at least a part of the electrolytic metal deposition.

20 9. Screen material (12) according to claim 8, characterized in that said screen material is obtained by using in the electrolytic bath a compound which contains at least one unsaturated bond not belonging to a  $\text{C}=\overset{\text{O}}{\underset{\text{I}}{\text{S}}}\text{=O}$  group.

**FIG: 1.****FIG: 2.****FIG: 3.**

FIG. 4.FIG. 5.FIG. 6.FIG. 7.FIG. 8.FIG. 9.FIG. 10.



European Patent  
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# EUROPEAN SEARCH REPORT

0049022

Application number

EP 81 20 1073

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	US - A - 2 260 893 (EWING) * Page 2, right-hand column, lines 1-65; figure 2 *	1-3, 6-8	C 25 L 1/08
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	GB - A - 1 199 404 (FOAM METAL LTD.) * Page 3, lines 15-16; figure 2 *	1-3, 6-8	
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	PLATING AND SURFACE FINISHING, vol. 66, no. 12, December 1979 SCHAER et al. "Electroforming accelerated by forced solution" pages 36-38.		TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
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			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
	The present search report has been drawn up for all claims		&: member of the same patent family, corresponding document
Place of search	the Hague	Date of completion of the search	Examiner
		05-01-1981	NGUYEN THE NGHIEP

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